PLUMBING

CHAPTER 13

TYPES

Plumbing consists of installing cast-iron and steel pipe, valves and fittings, fire hydrants, thrust blocks, concrete pipe, vitrified-clay pipe, and asbestos-cement pipe; roughing-in plumbing; and installing fixtures.

PIPE

The installation of cast-iron and steel pipe includes unloading, placing, joint makeup, and testing. The installation of concrete and vitrified-clay pipe includes unloading, placing, caulking, grouting, installing gaskets, and testing. The installation of asbestos-cement pipe includes unloading, placing, installing gaskets, soaping, pulling sleeve over joint, and testing.

VALVES AND FITTINGS

The installation of valves and fittings includes unloading, placing, caulking and leading, welding, and bolting flanges. It also includes installing gaskets, packing, handwheels, and trim.

FIRE HYDRANTS, POST INDICATOR VALVES, AND THRUST BLOCKS

The installation of fire hydrants and post indicator valves includes unloading, placing, caulking, bolting, clamping, adjusting to grade, and plumbing stems. The installation of thrust blocks includes bracing, forming, reinforcing, placing concrete, and stripping forms.

ROUGH IN PLUMBING

The roughing-in of plumbing includes unloading and installing sewer and drain pipe, installing water pipe, and testing. The installation of cast-iron drains includes caulking and leading joints, plumbing and grading pipe, installing pipe hangers and straps, cutting pipe, and installing fittings. The installation of galvanized-steel pipe vents and drains includes cutting and threading pipe, making joints and applying joint compound, plumbing and grading pipe, installing pipe hangers and straps, and installing fittings. The installation of copper and galvanized-steel water pipe includes cutting, threading, and making steel pipe joints; cleaning and soldering copper pipe joints; plumbing and grading pipe; and installing pipe hangers and straps.

The installation of plastic water pipe (polyvinyl chloride pipe) includes cutting, cleaning, and cementing; plumbing and grading pipe; and installing pipe hangers and straps.

FINISH PLUMBING

The installation of finish plumbing includes setting and connecting all plumbing fixtures (such as bathtubs, lavatories, water closets, urinals, showers, and sinks).

ESTIMATING TABLES

Tables 13-1 through 13-7, pages 13-3 through 13-9, may be used in preparing detailed man-hour estimates for plumbing installations. The tables do not include provision for loading and hauling equipment and materials to the jobsite. The installation of PVC pipe includes cleaning, applying solvent, drying time, and installation of hangers and supports. Table 13-8, pages 13-10, gives information on needed quantities of solvent.

EXAMPLE OF TABLE USE

Problem. Twenty housing units are to be constructed. Estimate the number of man-hours needed for rough in. Activity estimates show the following quantities:

Rough in sanitary lines (4-inch cast-iron and smaller) —— 145 joints

Rough in water lines (3/4-inch and smaller threaded pipe) —— 185 joints

Rough in fixtures:

Bathtub with shower	20 ea
Lavatory	20 ea
Water closet	20 ea
Kitchen sink	20 ea

Solution: Using Tables 13-1 through 13-8, the following computations are made:

4-inch and smaller cast-iron drain line . .	145 joints x 0.85 man-hours	= 123
3/4-inch and smaller water line	185 joints x 0.5 man-hours	= 93
Rough in fixtures:		
Bathtub with shower	20 ea x 4 man-hours	= 80
Lavatory	20 ea x 3 man-hours	= 60
Water closet	20 ea x 3 man-hours	= 60
Kitchen sink	20 ea x 3 man-hours	= 60
Total man-hours for rough in		= 476

Table 13-1. Installation of pipe-welded pipelines

Work element description	Unit	Man-hours/unit
Install schedule 40 pipe, by oxyacetylene welding, butt weld; positions include horizontal, vertical, and overhead:		
1-inch	joint	0.6
1 1/4-inch	joint	1.02
1 1/2-inch	joint	1.12
2-inch	joint	1.15
2 1/2-inch	joint	1.43
3-inch	joint	1.67
3 1/2-inch	joint	1.87
4-inch	joint	2.13
5-inch	joint	2.74
6-inch	joint	3.73
8-inch	joint	4.91
10-inch	joint	6.72
Install schedule 40 pipe, by metallic arc welding, butt welds; positions include horizontal, vertical, and overhead:		
1-inch	joint	0.5
1 1/4-inch	joint	0.5
1 1/2-inch	joint	0.5
2-inch	joint	0.5
2 1/2-inch	joint	0.5
3-inch	joint	0.5
3 1/2-inch	joint	0.75
4-inch	joint	0.75
5-inch	joint	0.75
6-inch	joint	0.85
8-inch	joint	0.85
10-inch	joint	1.0

NOTES:
1. The time for installation of the pipe includes erecting and aligning pipe in hangers, cutting and beveling one end of pipe, and welding pipe.
2. Schedule 40 steel pipe corresponds to former designation: "standard." Schedule 80 steel pipe corresponds to former designation: "extra strong." Schedule number is selected using formula: *Schedule Number = 1000xP/S*, where P is operating pressure, psig and S is allowable stress value, psi.
3. For schedule 80 pipe, multiply man-hours by 1.6.
4. This table is based upon a crew of 3 workers: 1 pipefitter, 1 welder, and 1 helper.

Table 13-2. Installation of thrust blocks, valves, and fittings—welded steel pipelines

Work element description	Unit	Man-hours/unit
Install thrust blocks for (2 worker crew):		
12-inch and smaller pipe	ea	6.40
14-to 24-inch pipe	ea	9.60
Install standard (welded) fittings, butt-welded, oxyacetylene and arc, all positions[1]:		
1-inch	ea	0.45
1 1/4-inch	ea	0.65
1 1/2-inch	ea	0.70
2-inch	ea	0.88
2 1/2-inch	ea	1.14
3-inch	ea	1.36
3 1/2-inch	ea	1.48
4-inch	ea	1.62
5-inch	ea	2.06
6-inch	ea	2.64
8-inch	ea	3.56
10-inch	ea	5.11
Install standard valves, oxyacetylene and metallic arc[2]:		
1-inch	ea	0.50
1 1/4-inch	ea	0.95
1 1/2-inch	ea	1.05
2-inch	ea	1.15
2 1/2-inch	ea	1.38
3-inch	ea	1.62
3 1/2-inch	ea	1.86
4-inch	ea	2.06
5-inch	ea	2.62
6-inch	ea	3.58
8-inch	ea	5.06
10-inch	ea	7.08

[1]This is based on the average time required to erect, align, and weld-up fittings. The crew consists of two workers: 1 welder and 1 helper. For extra-heavy fittings, multiply by a factor of 1.3.
[2]This is based on the average time is takes for a crew of 2 workers (welder and helper) to erect and align, and weld-out the fittings on the valve. For extra-heavy fittings, multiply by a factor of 1.5.

Table 13-3. Installation of steel pipe—threaded and flanged (schedule 40)

Work element description	Unit	Man-hours/unit
Install threaded and flanged valves (schedule 40):		
2-inch	ea	0.60
2 1/2-inch	ea	0.72
3-inch	ea	0.82
3 1/2-inch	ea	1.00
4-inch	ea	1.10
5-inch	ea	1.40
6-inch	ea	1.90
8-inch	ea	2.00
10-inch	ea	2.50
12-inch	ea	3.00
Install threaded pipe, schedule 40:		
1/2 - 3/4-inch	joint	0.50
1-inch	joint	0.50
1 1/4-inch	joint	0.50
1 1/2-inch	joint	0.50
2-inch	joint	0.50
2 1/2-inch	joint	0.50
3-inch	joint	0.75
3 1/2-inch	joint	0.75
4-inch	joint	0.75
5-inch	joint	1.00
6-inch	joint	1.00
8-inch	joint	1.50

Table 13-3. Installation of steel pipe—threaded and flanged (schedule 40) (continued)

Work element description	Unit	Man-hours/unit
Install schedule 40 pipe, flange fittings:		
2-inch	joint	0.25
2 1/2-inch	joint	0.25
3-inch	joint	0.25
3 1/2-inch	joint	0.35
4-inch	joint	0.35
5-inch	joint	0.35
6-inch	joint	0.50
8-inch	joint	0.50
10-inch	joint	0.65
12-inch	joint	0.75
Install thrust block:		
12-inch and smaller	ea	6.40
14-inch and larger	ea	9.60
Install flanged fittings (schedule 40):		
2-inch	ea	0.80
2 1/2-inch	ea	0.88
3-inch	ea	0.96
3 1/2-inch	ea	1.06
4-inch	ea	1.60
5-inch	ea	1.94
6-inch	ea	2.20
8-inch	ea	2.68
10-inch	ea	2.72
12-inch	ea	5.80

NOTES:
1. This table is based on the fabrication and installation of pipe per joint. The job operations taken into account are making fittings service tight, installing, handling materials and tools, and threading one end per joint.
2. The crew size in this table is based on 1 pipefitter and 1 helper for pipe under 4 inches. For pipe 4 inches and over, 1 pipefitter and 2 helpers are used.
3. For extra-heavy (schedule 80) pipe and screwed fittings, multiply by a factor of 2.
4. For schedule 120 pipe and screwed fittings, multiply by a factor of 3.
5. The time required to test a piping system is generally based on a percentage of the total amount of labor hours the job requires. The most accurate percentage to use is 6.

Table 13-4. Installation of vitrified-clay pipe

Work element description	Unit	Man-hours/unit
Install vitrified-clay pipe and fittings:		
4- to 6-inch	joint[1]	0.25
8-inch	joint[2]	0.30
10-inch	joint	0.50
12-inch	joint	0.60
15-inch	joint	0.95
18-inch	joint	1.10
21-inch	joint	1.25
24-inch	joint	1.40
30-inch	joint	1.75
36-inch	joint	2.00

[1]Joint size is 2 feet 6 inches.
[2]Joint size is 3 feet for all remaining pipe.
This table is based on a crew of 6 workers for all pipe up to and including 21 inches. For larger pipe, a crane and operator are needed, thus increasing the crew size to 7.

Table 13-5. Finish plumbing

Work element description	Unit	Man-hours/unit
Install fixture including all trim:		
Lavatory	ea	3
Water closet	ea	4
Stop sink	ea	4
Residential hot water heater	ea	3
Garbage disposal	ea	3
Urinal	ea	3
Bathtub	ea	5
Urinal with stall	ea	4
Footbath	ea	4
Kitchen sink	ea	5
Shower with stall	ea	8
Bathtub with shower	ea	7

NOTE: This table is based on a crew of 2 workers: 1 plumber and 1 helper.

Table 13-6. Rough in plumbing

Work element description	Unit	Man-hours/unit
Install sewer pipe:		
4- to 12-inch	ft	0.45
Install cast-iron drain lines and fittings:		
4-inch	joint[1]	0.85
6-inch	joint	1.00
8-inch	joint	1.30
Pipe work (steel) threaded pipe (schedule 40):		
1/2- to 3/4-inch	joint	0.50
1-inch	joint	0.50
1 1/4-inch	joint	0.50
1 1/2-inch	joint	0.50
2-inch	joint	0.50
2 1/2-inch	joint	0.75
3-inch	joint	0.75
3 1/2-inch	joint	1.00
4-inch	joint	1.00
Copper tubing[2]		
3/8- to 1/2-inch	joint	0.25
3/4-inch	joint	0.50
1 to 1 1/4-inch	joint	0.50
Roughing-in work:		
Lavatory	ea	3.00
Water closet	ea	3.00
Shower with stall	ea	8.00
Stop sink	ea	3.00
Urinal with stall	ea	3.00
Bathtub	ea	3.00
Kitchen sink	ea	3.00
Bathtub with shower	ea	4.00
Floor drain	ea	1.00
Grease trap	ea	2.00
Valves, faucets, etc., installed with rough plumbing:		
Less than 1-inch	ea	0.50
1- to 2-inch	ea	0.50
Over 2-inch	ea	0.75
Test plumbing system, per fixture		1.00

[1]A joint is the connection that joins pipe with pipe, pipe with a valve, pipe with a coupling, and so forth.
[2]Usually less than half as many joints will be required for copper tubing than for steel pipe of equal length.
This table is based on a crew of 2 workers: 1 plumber and 1 helper.

Table 13-7. Install polyvinyl chloride pipe, solvent welded

Work element description	Unit	Man-hours/unit
1/2-inch pipe	1,000 lin ft	2.9
3/4-inch pipe	1,000 lin ft	5.5
1-inch pipe	1,000 lin ft	8.0
1 1/4-inch pipe	1,000 lin ft	11.0
1 1/2-inch pipe	1,000 lin ft	13.5
2-inch pipe	1,000 lin ft	13.5
3-inch pipe	1,000 lin ft	13.5
4-inch pipe	1,000 lin ft	20.0
Fittings (time is based on per 10 fittings):		
Couplings:		
1/2-inch	per 10	0.3
1-inch	per 10	0.5
2-inch	per 10	0.9
3-inch	per 10	1.5
Elbows:		
1/2-inch	per 10	0.3
1-inch	per 10	0.5
2-inch	per 10	1.0
3-inch	per 10	1.5
4-inch	per 10	2.5
Tees:		
1/2-inch	per 10	0.4
1-inch	per 10	0.6
2-inch	per 10	1.5
3-inch	per 10	2.0
4-inch	per 10	2.5
Suggested crew size: 2 to 4 workers **NOTE:** Polyvinyl chloride solvent will not work with "C" polyvinyl chloride. Each must have a special solvent cement.		

Table 13-8. Polyvinyl chloride solvent requirements

Size fittings (in inches)	Number of joints	Pint number of couplings or elbows	Number of tees	Number of joints	Quart number of couplings or elbows	Number of tees
1/2	350	175	115	700	350	230
3/4	200	100	65	400	200	130
1	150	75	50	300	150	100
1 1/4	110	55	35	220	110	70
1 1/2	80	40	25	160	60	50
2	45	22	15	90	45	30
3	35	17	12	70	35	25
4	25	12	2	50	25	15
6	16	8	5	32	16	10
8	10	5	3	20	10	6